



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Longitudinal associations of cognitive ability, personality traits and school grades with antisocial behaviour

Citation for published version:

Mõttus, R., Guljaev, J., Allik, J., Laidra, K & Pullmann, H 2012, 'Longitudinal associations of cognitive ability, personality traits and school grades with antisocial behaviour', *European Journal of Personality*, vol. 26, no. 1, pp. 56-62. <https://doi.org/10.1002/per.820>

Digital Object Identifier (DOI):

[10.1002/per.820](https://doi.org/10.1002/per.820)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

European Journal of Personality

Publisher Rights Statement:

© Möttus, R., Guljaev, J., Allik, J., Laidra, K., & Pullmann, H. (2012). Longitudinal associations of cognitive ability, personality traits and school grades with antisocial behaviour. *European Journal of Personality*, 26(1), 56-62. [10.1002/per.820](https://doi.org/10.1002/per.820)

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



RUNNING HEAD: Predictors of criminal behaviour

Longitudinal associations of cognitive ability, personality traits, and school grades with
antisocial behaviour

René Mõttus^{a b d}

Juri Guljajev^a

Jüri Allik^{a b}

Kaia Laidra^{b c}

Helle Pullmann^{a b}

^a Department of Psychology, University of Tartu, Estonia

^b The Estonian Centre of Behavioural and Health Sciences

^c National Institute for Health Development, Estonia

^d Centre for Cognitive Ageing and Cognitive Epidemiology, University of Edinburgh,
UK

Word count: 4,879

Mailing Address:	René Mõttus Department of Psychology University of Tartu Tiigi 78, Tartu 50410 Estonia
E-mail:	rene.mottus@ut.ee
Phone:	+372 7375902

Abstract

This study investigated the role of adolescents' cognitive ability, personality traits, and school success in predicting later criminal behaviour. Cognitive ability, the Five-Factor Model personality traits, and the school grades of a large sample of Estonian schoolboys (N = 1,919) were measured between 2001 and 2005. In 2009, judicial databases were searched to identify participants who had been convicted of misdemeanours or criminal offences. Consistent with previous findings, having a judicial record was associated with lower cognitive ability, grade point average, Agreeableness, and Conscientiousness and higher Neuroticism. In multivariate path models, however, the contributions of cognitive ability and Conscientiousness were accounted for by school grades and the effect of Neuroticism was also accounted for by other variables, leaving grade point average and Agreeableness the only independent predictors of judicial record status.

Keywords: offenders; criminal; antisocial; delinquency; Five Factor Model; IQ; personality.

Introduction

IQ and antisocial behaviour

It is well documented that criminal offenders tend to have lower IQ scores than their law-abiding peers (Hirschi & Hindelang, 1977). The underpinnings of the relationship, however, are not fully understood, with at least four general explanations having been offered. First, the relationship may be spurious, with a third variable causing both low IQ test performance and antisocial behaviour. Poor social background has been offered as the most likely spurious variable. However, Moffitt, Gabrielli, Mednick, and Schulsinger (1981) investigated the link between IQ and delinquency in a large sample of Danish boys while controlling for socioeconomic status and found that the relationship held. Similar findings have been reported in other studies (e.g., Goodman, Simonoff, & Stevenson, 1995, but see also Fergusson, Horwood, & Ridder, 2005), suggesting that low IQ is probably related to antisocial behaviour independently of social background, at least to some extent. Other spurious variables remain possible, however.

Another non-causal explanation for the relationship is based on differential detection rates: low and high IQ boys behave antisocially to the same degree but, due to their less advanced skills, only those with lower IQs tend to get caught. However, this explanation has also not been corroborated by empirical findings. Moffitt and Silva (1988) compared the IQ scores of self-reported non-delinquents and delinquents while differentiating the offenders detected by the police from those that had remained undetected and found that both groups of delinquents had lower IQ scores than non-delinquents.

The third potential explanation is causal: antisocial behaviour and its correlates cause low performance in IQ tests (henceforth referred to as reverse causation). Antisocial lifestyle is often associated with drug and alcohol abuse, injuries, and discontinued

education, all of which may be detrimental to the cognitive abilities measured by IQ tests. Offenders may also have lower test-taking motivation than ordinary school children. However, longitudinal studies have shown that offenders tend to score lower in IQ tests long before they start their criminal careers (Moffitt et al., 1981).

Thus, we are most likely left with the fourth explanation, which sees low IQ as one of the causes of criminal behaviour (henceforth referred to as substantive causation). The substantive causation explanation, however, can be further differentiated. Firstly, it is possible that lower cognitive ability has a direct impact on criminal behaviour: in each and every life situation, lower ability people are less successful in choosing the most adaptive response to environmental conditions which, among other outcomes, makes them prone to antisocial behaviour. For instance, lower IQ may be associated with an inability to foresee the consequences of one's behaviour (Farrington, 2005). Secondly, it is also possible that lower cognitive ability causes antisocial behaviour indirectly: higher ability people are more successful at cumulatively acquiring the social and psychological resources that help them avoid the need for criminal behaviour. In young people, educational success is likely to be the most prominent protective resource providing access to alternatives for non-adaptive choices and reactions. In terms of indirect empirical evidence, we know that high cognitive abilities strongly predict school success (e.g. Neisser, Boodoo, Bouchard, et al., 1996) and the bulk of evidence shows that educational attainment is a protective factor against developing antisocial behaviour (e.g., Farrington, 2005; Johnson, McGue, & Iacono, 2009). A study that directly addressed the mediating role of educational success on later criminal behaviour, however, reported somewhat inconsistent results: Lynam, Moffitt, and Stouthamer-Loeber (1993) found that controlling for school success attenuated the relationship between IQ and antisocial behaviour in white but not in black adolescent

males. To our knowledge, there are few recent studies testing the mediating role of school success in the relationship between IQ and criminal behaviour.

In the present study, in addition to documenting the longitudinal relationship between IQ and antisocial behaviour, which itself confirms the absence of reverse causations, the potential role of school success in the association will be investigated.

Personality and antisocial behaviour

The overwhelming majority of previous research on the relationship between personality traits and antisocial behaviour has been based on Eysenck's PEN model of personality (Miller & Lynam, 2001). In this line of research, antisocial behaviour is usually found to be related to high scores on all of the PEN dimensions—Extraversion, Neuroticism, and, especially, Psychoticism (Miller & Lynam, 2001). However, more recently, the PEN model has lost much of its popularity among personality researchers because it is believed that a more optimal way of describing individual differences in personality is the Five-Factor Model (FFM; McCrae & John, 1992). The two models overlap to a considerable degree since they both share the Neuroticism and Extraversion domains. Yet, the FFM offers a more differentiated way of describing personality differences. In particular, Eysenck's Psychoticism, a trait of special interest in the case of antisocial behaviour, corresponds to two separate components of the FFM, Agreeableness and Conscientiousness (Costa & McCrae, 1995). The FFM also describes the Openness domain, which is not covered in the PEN model. FFM-based research on personality-criminality associations tends to show that antisocial behaviour is mainly predicted by low levels of Agreeableness and Conscientiousness and to some extent by high levels of Neuroticism (Miller & Lynam, 2001), which is generally in line with PEN-based findings.

However, the mechanisms of personality trait-delinquency associations have received less empirical scrutiny than the IQ-delinquency relationship. Specifically, there are only a few studies, especially among those based on the FFM, investigating the personality-antisocial behaviour relationship longitudinally. Shiner (2000), as one example, found that Academic Conscientiousness and Agreeableness measured at ages 8 to 12 predicted rule-abiding behaviour 10 years later. For non-FFM traits, Asendorpf, Denissen, and van Aken (2008) showed that children who were rated as more aggressive at ages 4 to 6 tended to show more criminal behaviour at age 23; Henry, Caspi, Moffit, and Silva (1996) showed that lack of control in pre-school children predicted later criminality. The relative paucity of longitudinal reports is unfortunate because measuring antisocial behaviour and personality traits concurrently, as has been done in most studies, or measuring personality after registering antisocial behaviour (e.g. Samuels, Bienvenu, Cullen et al., 2004; Lynam, Leukfeld, & Clayton, 2003), may lead to inconclusive findings. Having documented reliable differences between delinquents and non-delinquents, researchers may want to assume that the results point to substantive causation but, in fact, alternative explanations such as reverse causation may also be tenable, at least for some traits. In other words, it is possible that an antisocial lifestyle and its correlates affect individual differences in personality traits (Shiner, Masten, & Tellegen, 2002) rather than the other way around. For instance, it cannot be ruled out that an antisocial lifestyle makes people less trustful and tender-minded (i.e., lower on Agreeableness) and less dutiful (i.e., lower on Conscientiousness).

The present study helps to overcome the relative lack of longitudinal research on the relationships between FFM personality traits and antisocial behaviour by investigating the ability of adolescents' personality test scores, along with their cognitive ability and grades, to predict later misdemeanours and criminal offences.

Method

Sample

The Estonian NEO-FFI and Raven's Standard Progressive Matrices were administered to a large sample of Estonian adolescents attending 6th, 8th, 10th, and 12th grades. Data were collected in 2001, 2003, and 2005. In 2001, the sample was drawn from 27 Estonian-medium public secondary schools (for details see Allik, Laidra, Realo, & Pullmann, 2004). In 2003 and 2005, students from 17 schools (of the initial 27) participated. The schools were located in different regions of Estonia, covering all 15 Estonian counties, the capital and largest city, Tallinn, several smaller cities (Narva, Tartu, Pärnu, Kohtla-Järve, etc.), small towns, and rural areas.

The full sample consisted of 1,919 boys. At the time of initial testing, the boys' mean age was 14.61 years ($SD = 2.06$, ranging from 11 to 20; only 5 of the boys were 11 years old). This means that by summer 2009, when the boys were followed up in the judicial record database, the youngest of them was 15 (only one boy, however) and most of them were 16 years old (22 boys) or older (mean age 22.50, $SD = 2.66$). In Estonia, offenders have to be at least 14 years old to qualify for criminal punishment. Thus, by 2009, all of the boys were old enough to potentially have a record in the judicial database. Before the initial testing, consent to participate in the study was obtained from the adolescents or their parents.

Of note, the primary aim of the initial data collection was establishing Estonian norms for the Raven's Standard Progressive Matrices. Therefore, it was made sure that most of the 1,919 boys had completed this cognitive ability test (valid data were obtained from 99.32% of boys). Since it was considered less important at that time, for various reasons students' personality traits were not measured in some schools. Additionally, some teachers

were not willing to provide information on students' school grades. As a result, the number of boys with available data varies across variables (see Table 1).

Measures

NEO Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1992). All participants were asked to complete the Estonian NEO-FFI, which consists of 60 items; each of the five major personality dimensions—Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness—is represented by 12 items. The internal consistency estimates of the Estonian NEO-FFI subscales for the 6th to 12th graders were in the acceptable range, with Cronbach's alphas ranging from .67 for Agreeableness in the 8th, 10th, and 12th grades to .87 for Extraversion in the 12th grade (Laidra, Pullmann, & Allik, 2007, Table 1).

Raven's Standard Progressive Matrices (SPM). The SPM (Raven, 1981) measures abstract non-verbal problem-solving ability and is considered to be one of the purest measures of general intelligence (Jensen, 1998). The SPM consists of 60 items deployed in five blocks. In each item, one segment of a larger pattern is missing and subjects are asked to identify the missing segment to complete the pattern. For all grade levels, the Cronbach's alpha scores were acceptable, being far above 0.80 (reported in Laidra et al., 2007).

School success. Grade point averages (GPAs) were computed on the basis of participants' grades for the last semester or two previous quarters (division of the academic year differs across schools) in the following academic subjects: Estonian, Literature, two foreign languages (typically English and Russian or German), Mathematics, Chemistry, Physics, Geography, Biology, and History. Grades in Music, Drawing, and Physical Education were not included, because they require specific skills. Since not all of these

subjects are taught at all grade levels included in the study, the GPA for each participant is the average of as many grades as were available for him.

Judicial records

According to Estonian law, court verdicts are in the public domain (accessible at <http://kola.just.ee>). Possible records in the court verdict database were checked for all of the 1,919 boys. For a successful match, the offender's name, surname, and date of birth had to coincide with those of a person in our dataset (considering that less than 50 children were born daily in Estonia around the period the participants were born, the chances of mismatch were extremely small).

The records in the court verdict database fall into two categories: misdemeanours and criminal offences. Misdemeanours reflect administrative offences and can result in pecuniary punishment or arrest. Typical misdemeanours are traffic offences and various breaches of public order. Not all misdemeanours are listed in the database of court verdicts because misdemeanours are also processed by police and other institutions. Criminal offences generally reflect more serious offences which result in imprisonment or pecuniary punishment. All criminal offences are listed in the database of court verdicts. In essence, the difference between a misdemeanour and a criminal offence is in the seriousness of the offence. For this reason, we made the distinction between the two types of offences and divided offenders into two categories: (a) those with only a misdemeanour record and (b) those with at least one criminal record. Of the 1,919 participants, 78 (4.1%) had a judicial record, either indicating at least one criminal offence (henceforth criminals; $N = 53$) or at least one misdemeanour but no criminal offences (henceforth misdemeanants; $N = 25$). We do not differentiate between criminal offenders with and without supplementary misdemeanours because of the small number of the boys with both types of offences ($N =$

12) and the fact that the groups are inherently confounded (according to law, only criminal offences are punished if the offender has committed both types of offences).

Results

Univariate analyses

The personality trait and cognitive ability as well as GPA scores were standardized within each grade level in order to control for the effect of grade level on criminal behaviour. Descriptive statistics of the predictor variables for the three groups (non-offenders, misdemeanants, and criminal offenders), as well as correlations among them, are given in Table 1. Based on the literature reviewed above, we expected offenders to score higher on Neuroticism and lower on cognitive ability, GPA, Agreeableness, and Conscientiousness. These expectations were confirmed (Table 1, columns 2 to 4). Also, Openness tended to be lower in people with a judicial record.

Normally, criminal records represent more serious antisocial behaviour compared to misdemeanour records. Therefore, we treated the judicial record status as a categorical ordinal variable with three levels, representing non-offenders, misdemeanants, and criminal offenders. On the basis of ordinal probit regression (as implemented in Mplus 4.0), it appeared that judicial record status was significantly positively related to Neuroticism and negatively related to cognitive ability, GPA, Agreeableness, and Conscientiousness (Table 1, column 5). The association between decreasing Openness and increasing antisociality marginally fell short of statistical significance ($p = 0.07$). Among the predictors, GPA had by far the strongest association with the judicial record status.

Table 1 about here

Multivariate analyses

The intercorrelatedness of the predictors pointed to the possibility that the relationship to judicial record status may appear differently in multivariate analyses. In order to test the multivariate associations, we constructed a series of path models.

In the first model, to keep individual psychological differences apart from school achievement, we included only cognitive ability and personality traits as predictors of judicial record status (Extraversion, however, was not included in the model because it did not have any relationship to judicial record status in the univariate analysis). Specifically, judicial record status was regressed on psychological traits and the latter were allowed to covary. The model was implemented in Mplus 4.0, which estimated this using full information maximum likelihood; that is, the lower number of known values for personality traits did not mean the loss of any information related to the SPM, for which data from a somewhat larger number of people existed. Judicial record status was also regressed on the age of participants at the time of initial testing, in order to account for the possibility that older boys had had more time to become represented in the database of judicial records (for model parsimony, the psychological traits and GPA were not regressed on age as these variables had been standardized within grades and were therefore largely independent of age). The model was run using a mean- and variance-adjusted weighted least square (WLSMV) estimator.

In the multivariate model, only cognitive ability appeared to be a significant predictor of judicial record status (Table 2, column 2). Compared to the univariate results, the effects of Neuroticism, Agreeableness, and Conscientiousness had noticeably declined, although the effect of Agreeableness was close to the traditional significance level ($p < 0.08$). However, when the model was trimmed by step-wise dropping of non-significant paths, the effects of Agreeableness and Conscientiousness reached the significance level (Table 2, column 3; specifically, all paths were fixed to zero, one at a time, and the path for which fixing to zero

produced the lowest Wald statistic was dropped; the procedure was then repeated until the dropping of paths was no longer possible without significant deterioration of model fit; when the path from age to judicial record status was dropped, the age variable was removed from the model completely as it did no longer have a role there). The original model explained 8% and the trimmed model 7% of the variance in judicial record status.

Next, GPA was added to the model. As GPA and other predictors of judicial record status had been measured at the same time, it was impossible to *a priori* assume any causal relations between them. Strictly speaking, GPA may have been the result of psychological traits, or a cause of them, or these all might have been influenced by some other factors not covered by the available variables. Based on that, we allowed GPA to covary with other predictors without specifying any direction of causality between them. When all paths were retained in the model, only GPA predicted judicial record status. Most importantly, it reduced the predictive power of cognitive ability to zero. When the model was trimmed by step-wise dropping of non-significant paths, Agreeableness emerged as the second statistically significant predictor of judicial record status in addition to GPA. Conscientiousness did not significantly contribute to judicial record status even in the trimmed model. In both models—the original and the trimmed—the included predictors explained 17% of the variance in judicial record status.

In sum, having a record in the judicial database could most strongly be predicted by low school grades. Low cognitive ability, Agreeableness, and Conscientiousness, and high Neuroticism were also related to judicial record status in univariate analyses. When the predictors were entered simultaneously into the model, cognitive ability, Agreeableness and Conscientiousness were the strongest and significant predictors of judicial record status among the psychological traits. However, adding GPA to the model reduced the effects of cognitive ability and Conscientiousness close to zero.

Table 2 about here

Discussion

On the one hand, the results of the present study are consistent with previous findings (Fergusson et al., 2005; Lynam et al., 1993; Lynam et al., 2003). It appeared that boys who would later become criminal offenders demonstrated a lower ability to solve the abstract problems posed by SPM than their peers who would later be law-abiding. The chances of committing an offence were also raised by low Agreeableness and Conscientiousness and high Neuroticism.

The longitudinal design of the study diminished the possibility of reverse causation. That is, compared to studies where offences are measured concurrently with psychological traits, or even retrospectively (e.g., Samuels, et al., 2004; Lynam et al., 2003), the results of this study show that it is less likely that the ability and personality differences between offenders and non-offenders are the result of the former having and the latter not having a criminal history. This has been well documented for cognitive ability (e.g., Moffitt et al., 1981), but there have been fewer studies to date showing the power of the FFM personality traits to predict future antisocial behaviour. Yet, it has to be noted that, at the time of measuring their personality traits and cognitive ability, the boys were already at the age where their antisocial lifestyle may have already started, making some reverse causation still possible. Our results, thus, add some but not full support to the explanations based on substantive causation.

The multivariate analyses, however, showed that the effects of the different predictors on antisocial behaviour somewhat overlapped. Among the psychological traits, low cognitive ability, Agreeableness and Conscientiousness (but no longer Neuroticism) were

able to show independent contributions to antisocial behaviour; furthermore, when GPA was introduced to the model, the effects of cognitive ability and Conscientiousness were completely removed. For Neuroticism, the loss of predictive power in the multivariate model may have been related to the fact that the trait was substantially related to Agreeableness and Conscientiousness (see Table 1). That is, its apparent effect on the judicial record status in univariate analyses may have been a spurious relationship, at least partially. The fact that cognitive ability and Conscientiousness lost nearly all of their predictive power due to the inclusion of GPA may indicate that their effects on antisocial behaviour were mediated by school success.

Strictly speaking, the concurrent measurement of psychological traits and GPA—and the lack of information on potentially confounding variables such as family background or health status—did not allow us to assume that GPA was the outcome of cognitive ability or personality traits. Nevertheless, this is a viable possibility. Firstly, there are reasons to believe that GPA is a result, rather than a cause or simply a covariate, of the psychological traits. For instance, cognitive ability has been shown to predict school success longitudinally and this relationship cannot be fully ascribed to family characteristics (Fergusson et al., 2005); rather, it results, to a large degree, from genetic influences on the pre-existing level of ability (Johnson, Deary, & Iacono, 2009). Similarly, Conscientiousness predicts later educational attainment (Hampson, Goldberg, Vogt, & Dubanoski, 2007). Secondly, poor educational success has been shown to be related to the development of antisocial behaviour (e.g., Farrington, 2005; Johnson, McGue, & Iacono, 2009). Of course, seeing GPA as a potential mediator between cognitive ability and Conscientiousness on one side and antisocial behaviour on the other side is only one possible explanation for the findings. For instance, it is also possible that variables not measured in the present study (e.g., socioeconomic background, achievement motivation,

or mental health) caused individual differences in all of those variables (i.e. cognitive ability (or Conscientiousness) and GPA on one side and later antisocial behaviour on the other side).

Taken as a whole, we believe a likely interpretation of these results to be that psychological traits such as low cognitive ability, Agreeableness, and Conscientiousness are valid predictors of antisocial behaviour, but the effect of low ability and low Conscientiousness could potentially be explained by their associations with school success. It is worthwhile pointing out that the combination of these variables was able to explain as much as 17% of the variance in judicial record status years later. Thus, regardless of the exact mechanisms of the associations, information on adolescents' cognitive ability, personality traits and school success have remarkable practical value for predicting their future antisocial behaviour.

The study also has limitations. One of these was mentioned above: boys at ages 12 and older may have already had some contact with a criminal lifestyle which, in turn, may have influenced their ability, school grades, and personality traits. If this is true, some reverse causation is still possible. Another limitation is that, even with a sample of nearly 2,000, there were a limited number of boys with a judicial record, which cut down the statistical power to disentangle the predictors of offence status. This is a common problem in population-based studies of criminal behaviour, especially if an objective outcome is used to determine instances of this—criminal behaviour is not highly prevalent. A final limitation is related to having only self-report personality data: adolescents' ability to report on their personality traits may be lower compared to older people (Allik et al., 2004). As a result, the strength of the associations between personality traits and judicial record status may have been attenuated.

In sum, the study demonstrated that individual differences in the cognitive ability and personality traits of adolescents are predictive of later objectively determined antisocial behaviour. The study also discussed school success as a potential pathway in the associations between low ability, Conscientiousness and antisocial behaviour.

Author Note

The writing of this article was supported by a Mobilitas grant (MJD44, via the Estonian Science Foundation) from the European Social Fund to René Mõttus. This project was also supported by a grant from the Estonian Ministry of Science and Education (SF0180029s08) to Jüri Allik and by a Primus grant (3-8.2/60) from the European Social Fund to Anu Realo. Kaia Laidra was supported by grants from the Estonian Science Foundation (JD152) and from the Estonian Ministry of Science and Education (SF0940026s07).

References

- Allik, J., Laidra, K., Realo, A., & Pullmann, H. (2004). Personality development from 12 to 18 years of age: Changes in mean levels and structure of traits. *European Journal of Personality, 18*, 445-462.
- Asendorpf, J., Denissen, J. J. A., & van Aken, M. A. G. (2008). Inhibited and aggressive preschool children at 23 years of age: Personality and social transitions into adulthood. *Developmental Psychology, 44*, 997-1011.
- Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessment Resources.
- Costa, P. T., & McCrae, R. R. (1995). Primary traits of Eysenck's P-E-N system: Three- and five-factor solutions. *Journal of Personality and Social Psychology, 69*, 308-317.
- Farrington, D. P. (2005). Childhood origins of antisocial behaviour. *Clinical Psychology and Psychotherapy, 12*, 177-190.
- Fergusson, D. M., Horwood, L. J., & Ridder, E. M. (2005). Show me the child at seven II: Childhood intelligence and later outcomes in adolescence and young adulthood. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 46*, 850-858.
- Goodman, R., Simonoff, E., & Stevenson, J. (1995). The impact of child IQ, parent IQ and sibling IQ on child behavioural deviance scores. *Journal of Child Psychology and Psychiatry, 36*, 409-425.
- Hampson, S. E., Goldberg, L. R., Vogt, T. M., & Dubanoski, J. P. (2007). Mechanisms by which Childhood Personality Traits Influence Adult Health Status. *Health Psychology, 26*, 121-125.
- Henry B., Caspi A., Moffitt T. E., & Silva P. A. (1996). Temperamental and familial

- predictors of violent and nonviolent criminal convictions: Age 3 to age 18. *Developmental Psychology*, 32, 614-623.
- Hirschi, T., & Hindelang, M. J. (1977). Intelligence and delinquency: A revisionist review. *American Sociological Review*, 42, 571-587.
- Jensen, A. (1998). *The g Factor: The Science of Mental Ability*. Westport: Praeger.
- Johnson, W., Deary, I. J., & Iacono, W. G. (2009). Genetic and environmental transactions underlying educational attainment. *Intelligence*, 37, 466-478.
- Johnson, W., McGue, M., & Iacono, W. G. (2009). School performance and genetic and environmental variance in antisocial behavior at the transition from adolescence to adulthood. *Developmental Psychology*, 45, 973-987.
- Laidra, K., Pullmann, H., & Allik, J. (2007). Personality and intelligence as predictors of academic achievement: A cross-sectional study from elementary to secondary school. *Personality and Individual Differences*, 42, 441-451.
- Lynam, D., Moffitt, T. E., & Stouthamer-Loeber, M. (1993). Explaining the relation between IQ and delinquency: Class, race, test motivation, school failure, or self-control? *Journal of Abnormal Psychology*, 102, 187-196.
- Lynam, D. R., Leukefeld, C., & Clayton, R. R. (2003). The contribution of personality to the overlap between antisocial behavior and substance use/misuse. *Aggressive Behavior*, 29, 316-331.
- McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, 60, 175-215.
- Miller, J. D., & Lynam, D. (2001). Structural models of personality and their relation to antisocial behavior: A meta-analytic review. *Criminology*, 39, 765-798.
- Moffitt, T. E., Gabrielli, W. F., Mednick, S. A., & Schulsinger, F. (1981). Socioeconomic status, IQ, and delinquency. *Journal of Abnormal Psychology*, 90, 152-156.

- Moffitt, T. E., & Silva, P. A. (1988). IQ and delinquency: A direct test of the differential detection hypothesis. *Journal of Abnormal Psychology*, 97, 330-333.
- Muthén, B.O. (1998). *Mplus Technical Appendices*. Los Angeles, CA: Muthén & Muthén.
- Neisser, U., Boodoo, G., Bouchard, T. J., Jr., Boykin, A. W., Brody, N., Ceci, S. J., et al. (1996). Intelligence: Knowns and unknowns. *American Psychologist*, 51, 77-101.
- Raven, J. (1981). *Manual for Raven's Progressive Matrices and Mill Hill Vocabulary Scales*. Oxford: Oxford Psychologists Press.
- Samuels, J., Bienvenu, O. J., Cullen, B., Costa, P. T., Eaton, W. W., & Nestadt, G. (2004). Personality dimensions and criminal arrest. *Comprehensive Psychiatry*, 45, 275–280.
- Shiner, R. L. (2000). Linking childhood personality with adaptation: Evidence for continuity and change across time into late adolescence. *Journal of Personality and Social Psychology*, 78, 310-325.
- Shiner, R. L., Masten, A. S., & Tellegen, A. (2002). A developmental perspective on personality in emerging adulthood: Childhood antecedents and concurrent adaptation. *Journal of Personality and Social Psychology*, 83, 1165-1177.